Book Review
Useless Arithmetic: Why Environmental Scientists Can't Predict the Future

By: Kristen Cockerill

No Abstract

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Useless Arithmetic: Why Environmental Scientists Can't Predict the Future. O. H. Pilkey and L. Pilkey-Jarvis. 2007. Columbia University Press, New York. 230 pp. $29.95 paperback.

Humankind has a long history of seeking definitive answers to explain the complex systems operating on our home planet. Our tremendous success in calculating phenomena like atomic behavior and planetary movement has given us a false sense of confidence in our ability to calculate any and all phenomena. Our quest for definitive solutions to perceived problems has generated a sense of “physics envy” and driven many disciplines toward math-based predictive models. Orrin Pilkey and Linda Pilkey-Jarvis thoroughly discuss that our confidence in such models is misplaced. As a result, we are potentially increasing risk from natural hazards and have created a venue for ludicrous policy-based demands, such as certifying safety for tens of thousands of years at the Yucca Mountain nuclear waste repository.

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This book includes chapters on the crash of the Grand Banks fishery, Yucca Mountain, pit mines, invasive species, rising sea levels, and coastal erosion as examples of the problems in relying on predictive models in decision making. There is also a chapter providing an overview of the history of mathematical modeling and the types of models in play. Key points in the authors' critique are the role that assumptions play in model development, the cumulative effect

of small errors in a predictive model, the risk of allowing modeling to replace field-based observation and data gathering, and the mistaken idea that expressing the level of uncertainty (error bars) inherent in a model somehow resolves the error issue. The authors devote significant space to comparing an engineering mentality to a scientific mentality and are critical of the tendency for engineers to not “recognize the difference between the behavior of natural processes and the behavior of steel and concrete.” The whole of this book brought to mind Vannevar Bush's 1945 statement that, “If scientific reasoning were limited to the logical processes of arithmetic, we should not get far in our understanding of the physical world.”

This book is designed for a public audience and is an easy read. As the Preface explains, it intentionally relegates formula to the Appendix and does a fine job of explaining models without resorting to formula. The authors also provide a solid education in many geo-physical processes while describing shortcomings in predictive models related to those processes. Some potential readers may reject the book prematurely because of the senior Pilkey's reputation as a vocal critic of standard coastal engineering practices. Although there may be some legitimate quibbles with specific scientific conclusions drawn and some issues with citing (or lack thereof), these critiques miss the mark. The value in this book is in its call to question our reliance on predictive modeling as a method for living with complex, natural phenomena and to begin to think of alternative methods. This book should be required reading for policy makers who currently rely on predictive models and for the modelers themselves.

A core idea in the book is to continue the push for adaptive management approaches as a more flexible method than using predictive models to try to ensure status quo. The authors do understand that, “Flexibility in a democratic society … requires unusual courage and foresight on the part of politicians” and with this statement they hit upon the crux of the issue with quantitative modeling. Pilkey and Pilkey-Jarvis suggest that the public must be educated about math-based models and their shortcomings. There is, unfortunately, no explicit recognition that the quest for certainty seems to have deep roots in the human psyche and that the same desire that drove our ancestors to divine the future in chicken entrails allows us to put our trust in math-based models today. In policy making, definitive, engineering models “win” because they offer certainty and have been successful when viewed from a strictly human perspective. We have been terribly good at “controlling” the landscape in the short term. Therefore, attempts to educate will require that we try to inculcate a longer-term perspective, as well as reduce our faith in a seemingly certain answer. The authors' suggestions to allow for more qualitative, flexible policy approaches are an excellent start. Their concern is not with models in general and they in fact are quite supportive of qualitative, “what if” modeling techniques, like those used in collaborative modeling projects. There has been increasing attention to adaptive and collaborative approaches for managing the natural world. This book offers yet more evidence that these flexible, if less certain, methods offer a more complex, but more complete, way of working with the world.

REFERENCE

Bush, V. 1945. As We May Think. Atlantic Monthly (July).